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Synopsis V1.0
Single Event Latchup Testing of the
AD7664 Analog Devices Analog to Digital Converter

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I. Introduction

This study was undertaken to determine the latchup susceptibility AD7664 Analog Devices Analog to Digital Converter. The device was monitored for latchup induced high power supply currents by exposing it to a number of heavy ion beams at the Brookhaven National Laboratory Single Event Effects Test Facility.

II. Devices Tested

Devices were manufactured by Analog Devices, Inc. All devices were characterized prior to exposure.

III. Test Facility

Facility: Brookhaven National Laboratory Single Event Effects Test Facility

Flux: 6.5×10^2 to 1.0×10^4 particles/cm²/s.

Ion	Energy (MeV)	LET (MeVcm ² /mg)
Si	186	7.88
Ti	228	18.7
Br	284	37.2

IV. Test Methods

Temperature: The test was conducted at room temperature.

Test Hardware: Digitizing oscilloscope and programmable power supply.

Definition of a latchup event (SEL): Supply current monitored for an increase or decrease. Device functionality was also monitored by the "device busy" line.

V. Results

The Analog to Digital Converters were tested under the bias conditions of + 5 volts. The analog input to the device was a sinusoidal wave, 0 to 2 volts, at 5.1 kHz. During the testing the device power supply current was monitored and protected. The current trip point was set to either 40 or 50 mA (which would place the device out of specification for the mode it was being operated in and was a substantial enough rise in

current to indicate a latched condition). The “device busy” line was also monitored, on the digitizing oscilloscope, as an indication that the ADC was still operating correctly.

Two devices were tested, DUT #1 and #2. DUT #1 received the most testing as it was used to determine the latchup threshold LET. DUT #2 was then examined with the same ion that was used for final threshold testing for DUT #1. Both devices showed the same threshold characteristics with an LET threshold of 8-10 MeVcm²/mg. In all test conditions the DUT was exposed to the ion beam until latchup occurred. At this point the fluence was recorded. Typically 2 to 3 fluence readings were taken for each test condition, to allow for some statistics in calculating a cross section. This cross section data is shown in Figure 1.

Consider the cross section data in Figure 1. The two data points with the downward arrows are the LET value at which latchup did not occur (Silicon at normal incidence, LET = 7.88). The fluence for these cases was approximately 5×10^6 ions/cm² and the cross section is plotted at the inverse of this fluence. At the first angle measured for Silicon (30°), latchup occurred, thus the threshold between 8 and 10. While there is reasonable spread in the cross section data, an estimate of the saturation cross section can be made from the “best fit” curve through the data set. It is estimated to 2 to 3×10^{-4} cm².

The AD7664 Analog Devices Analog to Digital Converter is considered to have an LET threshold for latchup of approximately 8-10 MeV-cm²/mg. The saturation cross section is approximately 2 to 3×10^{-4} cm². It should be noted that for LET_{th} of 10 or less, the possibility of sensitivity to proton-induced events exists. This possibility is not addressed by this testing.

VI. Recommendations

In general, devices are categorized based on heavy ion test data into one of the four following categories:

- Category 1 – Recommended for usage in all NASA/GSFC spaceflight applications.
- Category 2 – Recommended for usage in NASA/GSFC spaceflight applications, but may require mitigation techniques.
- Category 3 – Recommended for usage in some NASA/GSFC spaceflight applications, but requires extensive mitigation techniques or hard failure recovery mode.
- Category 4 – Not recommended for usage in any NASA/GSFC spaceflight applications.

The AD7664 Analog Devices Analog to Digital Converter are Category 3 devices. If proton test would indicate a high sensitivity to proton induced latchup, this part could then be considered a Category 4 device.

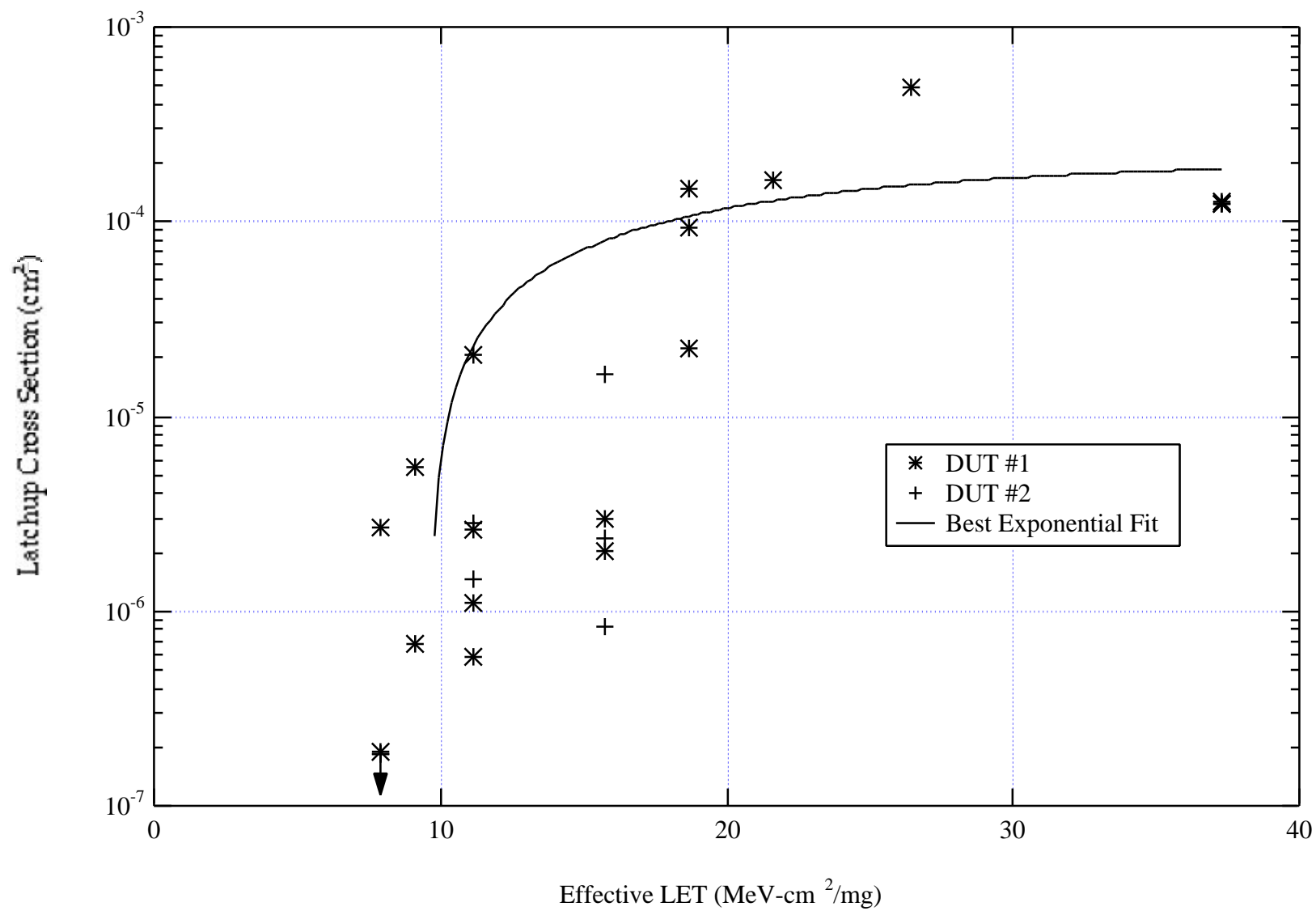


Figure 1. The symbols show the cross section data as a function of Effective LET for the two DUTs. Note: Symbols with a downward arrow indicate that no latch occurred for that LET.